DOCUMENT RESUME

ED 250 469 CE 039 898

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TITLE Welding Technology. A Competency Based Articulated Curriculum.
INSTITUTION Indian Hills Community Coll., Ottumwa, Iowa.
SPONS AGENCY Iowa State Dept. of Public Instruction, Des Moines.
PUB DATE 82
NOTE 44p.; For related documents, see CE 039 894-899. Developed in cooperation with Merged Area XV High Schools.
PUB TYPE Guides - Classroom Use - Guides (For Teachers) (052)

EDRS PRICE MF01/PC02 Plus Postage.
DESCRIPTORS *Articulation (Education); College School Cooperation; Competence; *Competency Based Education; *Course Content; Curriculum Development; Curriculum Guides; Educational Mobility; Educational Planning; Educational Policy; Institutional Cooperation; Job Analysis; *Job Skills; Metal Working; Occupational Information; Program Content; Secondary Education; Student Evaluation; Task Analysis; *Technical Occupations; Transfer Policy; Two Year Colleges; Vocational Education; *Welding

ABSTRACT

This document is a competency-based curriculum guide designed to promote articulation in welding technology programs between and among secondary and postsecondary institutions in the Indian Hills Community College and Merged Area XV high schools in Iowa. The guide is organized in eight sections. The first six sections provide background information about the articulation project, the audiences served and competencies developed, testing procedures, and provisions for transfer of credits. Section VII, which makes up the greater part of the document, details the 21 competencies needed by entry-level welders and the enabling tasks needed to become proficient in the competencies. Each competency consists of three parts that, when used in combination, provide a detailed outline of major tasks that a student must accomplish to reach one or more previously stated student outcomes. The three parts are the task that the student must accomplish, the conditions under which the student must demonstrate the skills, and standards of acceptable performance. The final section of the guide lists job titles available in the local area keyed to relevant competencies. (KC)

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IA 8213101

Indian Hills Community College
in cooperation with
Merged Area XV High Schools
presents

A COMPETENCY BASED
ARTICULATED CURRICULUM
FOR

WELDING TECHNOLOGY

A pilot project undertaken in
cooperation with The Iowa State
Department of Public Instruction

CE039898

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I. STATEMENT OF AUTHORSHIP

WELDING

The Director of this project is indebted to the following persons for their exemplary contributions to this publication. Compilation of this model reflects individual faculty preferences. Attempts to reproduce the effort with different faculty will likely produce variances in style.

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II. INTRODUCTION

INTRODUCTION

Indian Hills Community College, the twenty-six Local Education Agencies of Merged Area XV, Southern Prairie Area Education Agency XV (AEA), and the Iowa State Department of Public Instruction share a common commitment to offer current vocational opportunities to Iowans. This commitment has been demonstrated by undertaking a competency based Vocational Articulation project. In an effort to improve opportunities for students of secondary and post-secondary programs in Merged Area XV, those institutions mentioned above endeavored to create a solution to curricular problems such as redundancy, and gaps in subjects, occurring between secondary and post-seccndary institutions. On October 21, 1981, an effort toward modifying existing curriculum was initiated by the Iowa Department of Public Instruction, Indian Hills Community College, Southern Prairie Area Education Agency XV, and all local Education Agencies in Merged Area XV. Persons instrumental in conceiving the project include: Jim Athen, Director of Career Education and Dr. Howard Hammond, Director of Teacher Certification, State Department of Public Instruction; Dr. John Van Ast, Associate Professor of Higher Education, Iowa State University; Ed Kuntz, Principal of Ottumwa High School; and Dr. Stephen M. Poort, Dean of Instruction, Indian Hills Community College.

III. ACKNOWLEDGEMENTS

ACKNOWLEDGEMENTS

I am especially indebted to the members of the task force who provided sound counsel and strong support throughout the duration of this 24 month project. Task force members serving on behalf local secondary schools were: Dave Hotchkiss, Drafting (Ottumwa); Carol Gullion, Secretarial (Ottumwa); Ron Langgin, Electronics (Ottumwa); Keith Wells, Agriculture (Fairfield); Scott Moxom, Agriculture (Blakesburg); Harley Hecker, Welding (Ottumwa); and Carl Lawrence, Machine Shop (Ottumwa). Serving as task force members on behalf Indian Hills Community College were: Carl Moore, Drafting; Linda Poli and Connie Schmitz, Secretarial; Jerry Harshman, Electronics; Charles Rosenbalm and Dave McQuoid, Welding; and Everett Pilkington, Agriculture. Garland Ashbacher, Kirkwood Community College, served in support of the Agriculture model.

A special word of appreciation is due the following persons for their assistance in shaping the final form of this project. They are: Ed Kuntz, Principal and Ed Meyer, Vocational Director, Ottumwa High School; Don Smith, Consultant, State Department of Public Instruction; Ray Wingate, Educational Services Director, (AEA); Chuck Lawson, Vocational Director, Indian Hills; Bob Allison, Business Technologies Chairperson, Indian Hills; Dallas Dorsey, Trades and Industries Chairperson, Indian Hills; Betty Guest, Project Secretary; and Lew Debo and Shannon Vesely, Editors. Recognition should also be given to the selected private sector persons who helped on two occasions to reaffirm those competencies developed by task force members for each of the six vocational curriculum models.

It was our purpose to put forth a road map on the articulation process that could be emulated by interested educators elsewhere in Iowa. The effort described in this model is one of six end products of the total articulation process. Should the reader desire a copy of the final report he/she should contact Jim Athen, Director of Career Education, State Department of Public Instruction, Grimes State Office Building, Des Moines, Iowa 50319.

Stephen M. Poort, Ed.D
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IV.

PROJECT POLICY STATEMENT

DEFINITION OF ARTICULATION

AUDIENCES SERVED

COMPETENCIES DEVELOPED

PROJECT POLICY STATEMENT

DEFINITION OF ARTICULATION

Articulation, as defined in this project, is the sequential development of occupational competencies in a non-repetitive fashion building from simple to more complex competencies.

This project provides an articulated system for coordinating the preparation of students to enter the world of work. It is intended to: (a) assure the quality of training at various levels; (b) eliminate repetition and learning gaps as students move from one level of mastery to the next; (c) provide uniform methods of measuring acquired skills of students in various competencies; (d) record those measurements for the benefit of students, prospective employers, and educators who would improve quality of curriculum; (e) encourage employers to match personnel qualifications to specific job requirements; and (f) enable beginning students to understand what they are expected to learn.

AUDIENCES SERVED

Project materials are designed for use by any or all of the following educationally-related groups: students, teachers, administrators, counselors, private sector representatives, and college registrars. Applications vary in accordance with user needs; however, specific suggestions on recommended usage can be found in the body of the final report.

COMPETENCIES DEVELOPED

Competencies have been developed for each of the six vocational programs and articulated from the secondary to the post-secondary level. A separate listing of those competencies can be found in the body of each of the models.

V. TESTING PROCEDURES

TESTING PROCEDURES

The following represents those testing procedures in place as of June 30, 1984.*

	Test on Secondary Level	Test on Post-Secondary Level	Competency Record Maintained
AGRICULTURAL OCCUPATIONS	X		X
BUSINESS OCCUPATIONS	OPTIONAL	X	X
DRAFTING		X	X
ELECTRONIC TECHNOLOGY		X	X
MACHINE TRADES		X	X
WELDING OCCUPATIONS		X	X

For answers to more specific questions regarding testing competency based articulated curriculum, participants are encouraged to contact any of the task force representatives identified on the authors' page of this model.

*Additional information such as individual course listings can be provided by contacting any of the authors of this curriculum model as well as the college registrar.

VI. TRANSFER OF CREDIT

TRANSFER OF WELDING CURRICULUM

SECONDARY

EXAMFLE

COMPETENCIES	SEMESTER CREDITS	CATALOG NO.	COURSE

POST-SECONDARY

EXAMPLE

COMPETENCIES	SEMESTER CREDITS	CATALOG NO.	COURSE
1,2,3,4,5,6 7,8,9,10,11,12	6	WE012U	Welding I
13,14,15,16,17,18 19,20,21	6	WE022U	Welding II

VII. COMPETENCIES

COMPETENCIES

Each competency consists of three parts that, when used in combination, provide a detailed outline of a major task that a student must accomplish to reach one or more previously-stated student outcomes. Competencies are described as follows:

a. Task - what the student must accomplish to demonstrate ability to perform the job outlined.

b. Conditions - A description of the circumstances under which the student demonstrates the skill. Usually included are:

   1. time allowance;
   2. tolerances allowed;
   3. references utilized;
   4. specific materials and tools needed;
   5. work location (if other than school site);
   6. and, other limitations unique to the task.

c. Standards of Acceptable Performance - Criteria described that constitute acceptable performance.

   These criteria must:

   1. be compatible with the task and condition;
   2. evaluate all components of the conditions;
   3. include the percentage of responses that must be correct if the competency is primarily cognitive;
   4. and, specify the standard of the criteria.

Competencies needed for initial employment are represented in this model. They are neither designated nor described by grade level. A student may complete all competencies available at a school subject to learning capability and time limitations. Competencies listed in this model do not attempt to represent all those taught at any participating secondary or post-secondary school.

WELDING

COMPETENCY NO. 1

TASK:

To cut a flat piece of mild steel with a hand-held oxy-acetylene cutting torch.

CONDITIONS AND LIMITATIONS:

Given the proper tools and equipment (including an oxy-acetylene welding and cutting unit with a Purox No. 3 cutting tip in torch) and one piece of ¼" x 4" x 10" flat mild steel, the student will cut the material into four pieces ¼" x 2 ½" x 4". All work is to be done without reference materials and within a 15-minute time limit.

CRITERIA OF ACCEPTABLE PERFORMANCE:

The student will:

1. Verbally identify and describe the use of given tools and equipment.
2. Set up a cutting station that meets safety precautions. (Acceptable safety precautions are those listed in Hobart Workbook EW-2690W)
3. Light and adjust the cutting torch using the operating steps found in the lesson on (a) Adjust cutting assembly and (b) Cutting. (Note: Lesson can be found in Hobart Workbook EW-269 OAW - Topic 15).
4. Cut the given piece of metal into four straight rectangular pieces ¼" x 2½" x 4" (plus or minus ¼" of the desired size) without slag attached and with the cut edge exhibiting correct lag and drag.
5. Shut off torch and leave the equipment in acceptable storage condition.
6. Complete all work according to specifications and in a safe manner.
7. Complete the cutting assignment within the time limit.
8. Return the equipment to acceptable storage and working condition.

WELDING

COMPETENCY NO. 2

TASK:

To fusion weld mild steel in a flat position using the oxy-acetylene process.

CONDITIONS AND LIMITATIONS:

Given the proper tools and equipment (including an oxy-acetylene welding unit equipped with proper welding tip) and 24 pieces of 16 gauge mild steel 4" x 6" metal and 1/16" mild steel filler rod, the student will weld on the 6" side three each of butt joints, lap joints and open corner joints, and weld subject to them to a "U" bend test. The student will also weld and visually inspect three "T" joints. All work is to be done without reference material and within a 2½" hour time limit.

CRITERIA OF ACCEPTABLE PERFORMANCE:

The student will:

1. Set up a welding station that meets safety precautions and operating conditions according to the steps listed in Hobart Workbook EW-2690AW - Topic 3.

2. Light and adjust torch and flame as presented in Hobart Workbook EW2690AW - Topic 3.

3. Weld the joints in the flat position as described in Hobart Workbook EW-1290AW.
   a) The butt joint and lap joint must withstand the "U" bend test without breaking or showing visible defects.
   b) The "T" weld joint and open corner joint will exhibit visual inspection profiles.

4. Complete all work according to specifications and in a safe manner.

5. Complete the tasks within the time limit.

6. Return the equipment to acceptable storage and working conditions.

WELDING

COMPETENCY NO. 3

TASK

To fusion weld mild steel in a horizontal position using the oxy-acetylene process.

CONDITIONS AND LIMITATIONS:

Given the proper tools and equipment (including an oxy-acetylene welding unit equipped with proper welding tip), 24 pcs. 1/8" x 4" x 6" mild steel metal and 3/32 mild steel filler rod. The student will weld on the 6" side three each of butt joints, lap joints, and open corner joints and will subject them to "U" bends. The student will also weld and visually inspect three "T" joints. All work is to be done without reference material and within a 2½ hour time limit.

CRITERIA OF ACCEPTABLE PERFORMANCE:

The student will:

1. Set up a welding station that meets safety precautions and operating conditions according to the steps listed in Hobart Workbook EW-2690AW.

2. Light and adjust torch and flame as presented in Topic 3.

3. Weld the joints in horizontal positions as described in Hobart EW-2690AW.
   a) The butt joint and lap joint must withstand the "U" bend tests without breaking or showing visible defects.
   b) The "T" joints and open corner joint must pass visual inspection.

4. Complete all work according to specifications and in a safe manner.

5. Complete all tasks within the time limit.

6. Return the equipment to acceptable storage and working conditions.

WELDING

COMPETENCY NO. 4

TASK

To fusion weld mild steel in a vertical position using the oxy-acetylene process.

CONDITIONS AND LIMITATIONS:

Given the proper tools and equipment (including an oxy-acetylene welding unit equipped with proper welding tip), 24 pieces of 1/8" x 4" x 6" mild steel metal and 1/8" mild steel filler rod, the student will weld on the 6" side three each of butt joints, lap joints, and open corner joints and will subject them to "U" bends. The student will also weld and visually inspect three "T" joints. All work is to be done without reference material and within a 2½" hour time limit.

CRITERIA OF ACCEPTABLE PERFORMANCE:

The student will:

1. Set up a welding station that meets safety precautions and operating conditions according to the steps listed in Hobart Workbook EW-2690AW.

2. Light and adjust torch and flame as presented in Topic 3.

3. Weld the joints in the vertical position as described in Hobart Workbook EW-269)AW.
   a) The butt joint and lap joint must withstand the "U" bend test without breaking or showing visible defects.
   b) The "T" joints and open corner joint will pass visual inspections.

4. Complete all work according to specifications and in a safe manner.

5. Complete the tasks within the time limit.

6. Return the equipment to acceptable storage and working conditions.

WELDING

COMPETENCY NO. 5

TASK:

To fusion weld mild steel in an overhead position using the oxy-acetylene process.

CONDITIONS AND LIMITATIONS:

Given the proper tools and equipment (including an oxy-acetylene welding unit equipped with proper welding tip), 24 pieces of 1/8" x 4" x 6" mild steel metal and 1/8" mild steel filler rod, the student will weld on the 6" side three each of butt joints, lap joints, and open corner joints and will subject them to "U" bends. The student will also weld and visually inspect three "T" joints. All work is to be done without reference material and within a 2½ hour time limit.

CRITERIA OF ACCEPTABLE PERFORMANCE:

The student will:

1. Set up a welding station that meets safety precautions and operating conditions according to the steps listed in Hobart Workbook EW-2690AW.

2. Light and adjust torch and flame as presented in Topic 3.

3. Weld the joints in an overhead position as described in workbook.
   a) The butt joint and lap joint must withstand the "U" bend test without breaking or showing visible defects.
   b) The "T" weld joint and open corner joint will exhibit visual inspection profiles.

4. Complete all work according to specifications and in a safe manner.

5. Complete the task within the time limit.

6. Return the equipment to acceptable and working conditions.

WELDING

COMPETENCY NO. 6

TASK:

To braze weld mild steel in a flat and horizontal position using the oxy-acetylene process.

CONDITIONS AND LIMITATIONS:

Given the proper tools and equipment (including an oxy-acetylene welding unit equipped with proper welding tip), 36 pieces of 16 gauge 4" x 6" mild steel metal and 3/32 bronze filler rod, the student will weld on the 6" side three each of butt joints, lap joints, and "T" joints in each position (flat and horizontal). The butt joints and lap joints will be subjected to a "U" bend test. The "T" joint will be subjected to visual inspection. All work is to be done without reference material and within a 3 hour time limit.

CRITERIA OF ACCEPTABLE PERFORMANCE:

The student will:

1. Set up a welding station that meets safety precautions and operating conditions according to Hobart Workbook EW-2690AW.

2. Light and adjust the torch and flame as presented in Topics 25 and 26.

3. Weld joints in the flat and horizontal positions.
   a) The butt weld and lap weld must withstand the "U" bend without breaking or showing visible defects.
   b) The "T" weld joint must pass visual inspection.

4. Complete all work according to specifications and in a safe manner.

5. Complete the tasks within the time limit.

6. Return the equipment to acceptable storage and working conditions.

WELDING

COMPETENCY NO. 7

TASK:

To fusion weld pipe in the 2G position, 5 G position and the 6 G position using the oxy-acetylene process.

CONDITIONS AND LIMITATIONS:

Given the proper tools and equipment (including an oxy-acetylene welding unit equipped with proper welding tip) 12 pieces of pipe beveled for welding and 1/8" mild steel filler rod, the student will weld 2 each of the 2 G position, 5 G position, 6 G position. Pipe shall not be turned or rolled while welding. All work to be done without reference material and within a 3½ hour time limit.

CRITERIA OF ACCEPTABLE MATERIAL:

The student will:

1. Set up a welding station that meets safety precautions and operating conditions according to the steps listed in Hobart Workbook EW-2690AW.

2. Light and adjust torch and flame as presented in Topics 23 and 24.

3. Weld the joints in each of the 3 positions using 2 passes to complete weld joint.
   a) First pass or root bead should penetrate the joint and fill almost 2/3 of the joint.
   b) The finished bead face should be slightly convexed and 1/2" wide to pass visual inspection.

4. Complete all work according to specifications and in a safe manner.

5. Complete the tasks within the time limit.

6. Return the equipment to acceptable storage and working conditions.

WELDING

COMPETENCY NO. 8

TASK:

To fusion weld continuous and parallel stringer beads using the shielded metal arc welding process.

CONDITIONS AND LIMITATIONS:

A. Flat position

Given the proper tools and equipment (Including AC/DC arc welding equipment(a 3/8" x 4" x 6" plate of steel and E6010 electrodes 5/32" diameter, the student will run parallel and continuous stringer beads in the flat position 3/4" apart for the 6" length of the plate. All work is to be done without reference materials and within 30 minute time limit.

B. Horizontal position

Given proper tools and equipment (including AC/DC arc welding equipment, a ¼ x 4" x 6" plate of steel and E6011 electrodes 1/8" in diameter, the student will run parallel and continuous stringer beads in the horizontal position 3/4" apart for the 6" length of the plate. All work is to be done without reference material and within a 30 minute time limit.

C. Vertical up position

Given the proper tools and equipment (including AC/DC arc welding equipment), a ½" x 4" x 6" plate of steel and E7018 electrodes 1/8" in diameter, the student will run parallel and continuous stringer beads in the vertical up position 3/4" apart for the 6" length of the plate. All work is to be done without reference material and within a 30 minute time limit.

CRITERIA OF ACCEPTABLE PERFORMANCE:

For each of the given conditions, the student will:

1. Set up the welding station according to the Hobart Workbook EW-269-SMAW-B

WELDING

COMPETENCY NO. 8 (Continued)

CRITERIA OF ACCEPTABLE PERFORMANCE: (CONT'D)

For each of the given conditions, the student will:

2. Prepare the plate by layout of lines with soapstone, 3/4" apart for the length of the plate, ½" off the edge of the plate.

3. Adjust the welding machine to the correct polarity setting according to the electrode specification as posted in electrode selection guide.

4. Strike an arc and run a continuous bead using the full length of the electrode, filling crater to height of bead.

   a) The beads shall pass visual inspection as set forth in Topic 7 EW269-SMAW-B Workbook.

5. Complete all work within the time limit.

6. Complete all work according to specifications and in a safe manner.

7. Return the equipment to acceptable storage and working conditions.

WELDING

COMPETENCY NO. 9.

TASK:

To fusion weld in a flat position a multiple-pass buildup using the shielded metal arc welding process.

CONDITIONS AND LIMITATIONS:

Given the proper tools and equipment (including AC/DC arc welding equipment), a ½" x 3" x 3" mild steel plate and E6013 electrodes 1/8" in diameter, the student will build up the plate to a total height of 1½", using multiple pass build up welding techniques in the flat position. When the weld is completed the plate steel should have a machinability compared to cold drawn bar steel. All work is to be done without reference material and within a one-hour time limit.

CRITERIA OF ACCEPTABLE PERFORMANCE:

The student will:

1. Set up the welding station according to the Hobart safety precautions:

2. Clean the slag from the first bead, and run another bead parallel to the first. Continue this process for the width of the metal, cleaning each bead.

   a) The beads will be checked for uniformity, slag pockets, and inclusions.

   b) Each layer of beads will run at right angles to the previous layers of beads until a 1" build-up is obtained.

   c) The pad will be air cooled. (Do not use water)

   d) The beads on the surface will have a smooth finish, minor valleys or depressions between the beads.

   e) Each layer of beads will be fused with no slag inclusions or holes between the beads.

3. Complete all work within the time limit.

4. Complete all work according to specifications and in a safe manner.

5. Return all equipment to acceptable storage and working conditions.

WELDING

COMPETENCY NO. 10

TASK:

To fusion weld mild steel in a flat position using the shielded metal arc welding process.

CONDITIONS AND LIMITATIONS:

Given the proper tools and equipment (including AC/DC arc welder) E7018 electrodes 1/8" in diameter and 16 plates of mild steel 1/4" x 2" x 6", the student will tack-weld two each of open corner, "T", lap, and butt joints in the flat position. Joints are to be formed using the 6" side of the metal and running the 6" long beads by breaking and restarting at the midpoint of the weld beads. Joints will be subjected to visual and destructive tests. All work is to be done without reference materials and within a 1½ hour time limit.

CRITERIA OF ACCEPTABLE PERFORMANCE:

The student will:

1. Set up the welding station according to the Hobart safety precautions.

2. Prepare the plates for each of the joints by tack welding them into position with a 1/8" root opening.

3. Run the 6" long beads, breaking and restarting at the mid-point of the weld beads.

   a) The beads must pass visual inspection.

   b) All joints will be visually inspected. The "T" joints will be destructive tested.

4. Complete all work within the time limit.

5. Complete all work according to specifications and in a safe manner.

6. Return the equipment to acceptable storage and working conditions.

WELDING

COMPETENCY NO. 11

TASK:

To fusion weld mild steel in a horizontal position using the shielded metal arc welding process.

CONDITIONS AND LIMITATIONS:

Given the proper tools and equipment (including AC/DC arc welder), E6011 electrodes 1/8" in diameter and 12 plates of ¼" x 2" x 6" mild steel, the student will tack-weld and weld two each of open corner, "T" and lap joints in the horizontal position using the 6" side of the metal. Joints will be subjected to visual and destructive tests. All work is to be done without reference material and within a 1½ hour time limit.

CRITERIA OF ACCEPTABLE PERFORMANCE:

The student will:

1. Set up the welding station according to the Hobart safety precautions.

2. Prepare the plates for each of the joints. The plates are to be tack welded with a 1/8" root opening.

   a) The beads will pass visual inspection.

   b) All joints will pass visual inspection. The "T" joints will pass the destructive test.

3. Complete all work within the time limit.

4. Complete all work according to specifications and a safe manner.

5. Return the equipment to acceptable storage and working conditions.

WELDING

COMPETENCY NO. 12

TASK:

To fusion weld mild steel in a vertical-down position using the shielded metal arc welding process.

CONDITIONS AND LIMITATIONS:

Given the proper tools and equipment (including AC/DC arc welder), E6013 electodes 1/8" in diameter and 12 plates of 1/4" x 2" x 6" mild steel, the student will tack weld and weld two each of open corner, "T" and lap joints in the vertical-down position. Joints are to be formed using the 6" side of the metal. Joints will be subjected to visual and destructive tests. All work is to be done without reference material and within a 1½ hour time limit.

CRITERIA OF ACCEPTABLE PERFORMANCE:

The student will:

1. Set up the welding station according to the Hobart safety precautions.

2. Prepare the plates for each of the joints. The plates are to be tack welded in position according to specifications set forth by the Hobart Workbook.

   a) The beads will pass visual inspection.

   b) All joints will be visually inspected and the "T" joint will be destructive tested.

3. Complete all work within the time limit.

4. Complete all work according to specifications and in a safe manner.

5. Return the equipment to acceptable storage and working conditions.

WELDING

COMPETENCY NO. 13

TASK:

To fusion weld mild steel in a flat position using the gas metal arc welding process.

CONDITIONS AND LIMITATIONS:

Given the proper tools and equipment (including a G.M.A.W. constant potential power supply, welding grade CO 2 shielding gas, wire feeder, air-cooled gun for short arc applications, using .035 wire) and 16 pieces of 1/8" x 2" x 6" mild steel, the student will tack weld and weld two each of the following joints on the 6" side of the metal, outside corner, lap, "T" and square groove butt with 1/8" root opening. All weld joints are to be subjected to visual inspections, and the "T" joints will also be subjected to a destructive break test. The student may use as reference the Hobart Gas Metal-arc Workbook EW269 GMAW-B. All work is to be completed within a one hour time limit.

CRITERIA OF ACCEPTABLE PERFORMANCE:

The student will:

1. Set up the equipment for the gas metal arc welding process according to the operating steps set forth in the Hobart Workbook EW269 GMAW-B.

2. Adjust the welder for proper short arc welding applications.

3. Position and tack weld the plates.

   a) All welds to pass visual inspection for weld profiles.

   b) The "T" joint will withstand the break test.

4. Complete all work within the time limit.

5. Complete all work in a safe manner.

6. Return all equipment to acceptable storage and working conditions.

WELDING

COMPETENCY NO. 14

TASK:

To fusion weld mild steel in a horizontal position using the gas metal arc welding process.

CONDITIONS AND LIMITATIONS:

Given the proper tools and equipment (including a G.M.A.W. constant potential power supply, welding grade CO 2 shielding gas, wire feeder, air-cooled gun for short arc applications, using .035 wire) and 16 pieces of 1/8" x 2" x 6" mild steel, the student will tack weld and weld two each of the following points on the 6" side of the metal, outside corner, lap, "T" and square groove butt with 1/8" root gap. All weld joints are to be subjected to visual inspections, and the "T" joint will be subjected to a destructive break test. All work is to be completed within a one hour time limit.

CRITERIA OF ACCEPTABLE PERFORMANCE:

The student will:

1. Set up the equipment for gas metal arc welding process according to the operating steps set forth in the Hobart Workbook EW 269 GMAW-B.
2. Adjust the welder for proper short arc welding applications.
3. Position and tack weld plates.
   a) All welds to pass visual inspection for weld profiles.
   b) The "T" joint will withstand the break test.
4. Complete all work within the time limit.
5. Complete all work in a safe manner.
6. Return the equipment to acceptable storage and working conditions.

WELDING

COMPETENCY NO. 15

TASK:

To fusion weld mild steel in a flat position using the gas metal arc welding process with the spray transfer technique.

CONDITIONS AND LIMITATIONS:

Given the proper tools and equipment (including a G.M.A.W. constant potential power supply, 95% argon 5% oxygen shielding gas, wire feeder, air-cooled gun for spray arc applications, using .045 diameter filler wire), four pieces of 3/8" x 3" x 6" and two pieces of 3/8" x 2" x 7" mild steel plates, the student will tack weld and weld two beveled butt joints with a backup strip on the 6" side of the metal. Both joints will pass visual inspection and destructive tests. All work to be completed within a one hour time limit.

CRITERIA OF ACCEPTABLE PERFORMANCE:

The student will:

1. Set up equipment for the gas metal arc welding process for spray arc transfer application.
2. Adjust the welder to correct spray arc currents.
3. Position and tack weld the plates.
   a) All welds must pass visual inspection.
   b) All welds must pass destructive tests.
4. Complete all work in a safe manner.
5. Complete all work within the time limit.
6. Return the equipment to good working condition.

WELDING

COMPETENCY NO. 16

TASK:

To weld beads on aluminum plate in the flat position using the gas tungsten arc welding process.

CONDITIONS AND LIMITATIONS:

Given the proper tools and equipment (including an AC transformer power source with superimposed high frequency current, a welding torch equipped with 1/8" diameter tungsten electrode, argon gas, stainless steel wire brush, and necessary accessories), two ¼" x 6" x 12" pieces of aluminum plates, and 3/32" filler rod, the student will run four 12" long beads one inch apart on each plate (a total of eight beads 12" long). The task is to be completed within a one hour time limit.

CRITERIA OF ACCEPTABLE PERFORMANCE:

The student will:

1. Set up the welding station for Tig welding aluminum.
2. Clean and prepare material in preparation for welding.
3. Set up welding equipment and adjust argon gas flow and welding machine to proper settings for welding aluminum plates.
4. Strike the arc, form a weld pool and make 12" long beads, four on each plate, with proper bead width, toe lines, ripple formation, bead contour and penetration. Beads will be straight and even in width.
5. Complete all work within time limit.
6. Complete all work according to specifications set forth and in a safe manner.
7. Return the equipment to acceptable storage and working condition.

WELDING

COMPETENCY NO. 17

TASK:

To make flat position single pass fillet welds on aluminum sheet using gas tungsten arc welding process.

CONDITIONS AND LIMITATIONS:

Given proper tools and equipment (including an A/C transformer power source with superimposed high frequency current, a welding torch equipped with 3/32" diameter tungsten electrode, argon gas, stainless steel wire brush, and necessary accessories), six 1/8" x 6" x 6" aluminum sheets, 3/32" filler rod, the student will tack weld and run three 6" long "T" fillet beads, breaking and restarting at the mid-points of the beads, using the six plates. Joints will be subject to destructive testing. Task to be completed within a one hour time limit.

CRITERIA OF ACCEPTABLE PERFORMANCE:

1. Set up welding station acceptable for Tig welding aluminum.
2. Clean and prepare aluminum suitable for welding.
3. Select proper settings on equipment, and argon flow rate for welding aluminum.
4. Tack weld to sheets on each end in preparation to weld a "T" fillet in the flat position on the 6" long side of "T" joint.
5. Strike the arc, form a weld pool, and run a 6 inch long bead, breaking and restarting at the midpoint of the weld bead, producing the proper bead width, toe lines, ripple formation, bead contour, and penetration.
6. Prepare and free-bend test the "T" joints.
7. Complete all work within the time limit.
8. Complete all work according to specifications and a safe manner.
9. Return the equipment to acceptable storage and working conditions.

WELDING

COMPETENCY NO. 18

TASK:

To make flat position single pass butt welds on aluminum sheet using the gas tungsten arc welding process.

CONDITIONS AND LIMITATIONS:

Given proper tools and equipment (including an A.C. transformer power source with superimposed high frequency current, a welding torch equipped with 1/8" diameter tungsten electrode, argon gas, stainless steel wire brush and necessary accessories), six 3/16" x 6" x 12" aluminum sheets and 3/32" filler rod, bend fixture, the student will bevel abutting edges and run three "V" groove butt joints 12" long. Joints will be subjected to visual and destructive testing. The task is to be completed within a two hour time limit.

CRITERIA OF ACCEPTABLE PERFORMANCE:

The student will:

1. Set up the welding station acceptable for Tig welding aluminum.
2. Bevel abutting edges of the sheet of aluminum for flat position single pass butt welding.
3. Complete the preparation of the material to be welded where the weld will be placed.
4. Select proper settings on the equipment, adjust argon flow for welding aluminum.
5. Arrange the weld joint with 1/8" root opening without jigs, and tack weld in position for welding a single pass butt weld on aluminum sheets in the flat position.
6. Strike the arc, form a weld pool, run the three 12" long beads the full length of the weld joint producing the proper bead width, toe lines, ripple formation, bead contour and penetration to meet welding standard.
7. Prepare bend test.
8. Complete all work within the time limit.
9. Complete all work according to specification and in a safe manner.
10. Return all equipment to acceptable storage and working conditions.

WELDING

COMPETENCY NO. 19

TASK:

To make flat position multi-pass fillet welds on aluminum plate using the gas tungsten arc welding process.

CONDITIONS AND LIMITATIONS:

Given the proper tools and equipment (including an A.C. transformer power source with superimposed high frequency current, a welding torch equipped with 1/8" diameter tungsten electrode, argon gas, stainless steel wire brush and necessary accessories), four ¼" x 6" x 6" aluminum plates and 3/32" filler rod, the student will tack weld and run two 12" long "T" fillet joints, breaking and restarting at the midpoint of the joints. Joints will be subjected to visual inspection. The task is to be completed within a two hour time limit.

CRITERIA OF ACCEPTABLE PERFORMANCE:

The student will:

1. Set up the welding station acceptable for Tig welding aluminum.
2. Thoroughly brush the surfaces with the stainless steel wire brush removing all surface aluminum oxide where the weld bead will be placed and brush between passes.
3. Select proper settings on the equipment, adjust argon flow meter for welding aluminum.
4. Tack weld two plates on each end.
5. Strike an arc, form a pool, run two 6" long joints the full length of the weld joint, breaking and restarting at the midpoint of each weld bead, producing proper bead width, toe lines, ripple formation, bead contour, penetration to meet welding standards.
6. Complete all work within the time limit.
7. Complete all work according to specifications and in a safe manner.
8. Return the equipment to acceptable storage and working conditions.

WELDING

COMPETENCY NO. 20

TASK:

To make flat position multi-pass butt welds on aluminum plate using the gas tungsten arc welding process.

CONDITIONS AND LIMITATIONS:

Given proper tools and equipment (including an A.C. transformer power source with superimposed high frequency current, a welding torch equipped with 1/8" diameter tungsten electrode, argon gas, stainless steel wire brush and accessories), four 1/2" x 6" x 12" aluminum plates and 3/32" aluminum filler rod, bend test fixture, the student will bevel abutting edges, tack weld and run two 12" long "V" groove butt joints using four plates. Joints will be subjected to visual and destructive testing. The task is to be completed within a two hour time limit.

CRITERIA OF ACCEPTABLE PERFORMANCE:

The student will:

1. Set up the welding station acceptable for Tig welding aluminum.
2. Bevel the edges of the plate to the correct degree for welding a flat position multi-pass butt weld on aluminum plate.
3. Thoroughly brush the surfaces with stainless steel wire brush, removing all surface aluminum oxides where the weld bead will be placed, and brush between passes.
4. Select proper machine settings and adjust argon flow meter for welding aluminum.
5. Arrange the weld joints with 1/8" root opening and level, tack weld and prepare to weld.
6. Strike the arc, form a weld pool, run the two 12" joints the full length of the weld joint and, following the proper pass sequence, produce the proper bead width, toe lines, ripple formation, bead contours and penetration to meet welding standards.
7. Prepare and free bend test the butt joints.
8. Complete all work within the time limit.
9. Complete all work according to specifications and in a safe manner.
10. Return the equipment to acceptable storage and working conditions.

WELDING

COMPETENCY NO. 21

TASK:

To make horizontal multi-pass welds on aluminum plate using gas tungsten arc welding process.

CONDITIONS AND LIMITATIONS:

Given the proper tools and equipment (including an A.C. transformer power source with superimposed high frequency current, a welding torch equipped with 1/8" diameter tungsten electrode, argon gas, stainless steel wire brush and necessary accessories), four 1/2" x 6" x 12" aluminum plates and 3/32" aluminum filler rod, the student will tack weld and run two 12" long "T" fillet joints, breaking and restarting at midpoint of the joints. Joints will be subjected to visual inspection. The task is to be completed within a two hour time limit.

CRITERIA OF ACCEPTABLE PERFORMANCE:

The student will:

1. Set up the welding station acceptable for Tig welding aluminum.
2. Thoroughly brush the surfaces with a stainless steel wire brush, removing all surface aluminum oxide where the weld bead will be placed and brush between passes.
3. Select proper machine settings and regulate argon flow meter to properly weld aluminum.
4. Tack weld two plates on each end for welding a horizontal position multi-pass fillet weld.
5. Strike the arc, form a pool, run two 12" long joints the full length of the weld joint breaking and restarting at the mid-point of each weld bead and following the proper pass sequence, producing the proper bead width, toe lines, ripple formations, bead contour and penetration to meet welding standards for welding aluminum.
6. Present for visual inspection.
7. Complete all work within the time limit.
8. Complete all work according to specificaions and in a safe manner.
9. Return the equipment to acceptable storage and in good working condition.

COMPETENCY NO. 21

TASK:

To make horizontal multi-pass welds on aluminum plate using gas tungsten arc welding process.

CONDITIONS AND LIMITATIONS:

Given the proper tools and equipment (including an A.C. transformer power source with superimposed high frequency current, a welding torch equipped with 1/8" diameter tungsten electrode, argon gas, stainless steel wire brush and necessary accessories), four 1/2" x 6" x 12" aluminum plates and 3/32" aluminum filler rod, the student will tack weld and run two 12" long "T" fillet joints, breaking and restarting at midpoint of the joints. Joints will be subjected to visual inspection. The task is to be completed within a two hour time limit.

CRITERIA OF ACCEPTABLE PERFORMANCE:

The student will:

1. Set up the welding station acceptable for Tig welding aluminum.
2. Thoroughly brush the surfaces with a stainless steel wire brush, removing all surface aluminum oxide where the weld bead will be placed and brush between passes.
3. Select proper machine settings and regulate argon flow meter to properly weld aluminum.
4. Tack weld two plates on each end for welding a horizontal position multi-pass fillet weld.
5. Strike the arc, form a pool, run twol2: long joints the full length of the weld joint breaking and restarting at the midpoint of each weld bead and following the proper pass sequence, producing the proper bead width, toe lines, ripple formations, bead contour and penetration to meet welding standards for welding aluminum.
6. Present for visual inspection.
7. Complete all work within the time limit.
8. Complete all work according to specifications and in a safe manner.
9. Return the equipment to acceptable storage and in good working condition.

VIII. JOB OPPORTUNITIES

JOB OPPORTUNITIES

Many of the competencies listed in this booklet lead to jobs that are available in the 10 counties served by the 26 Local Education Agencies and Indian Hills Community College in Southeastern Iowa. Students, teachers, and counselors may use the following information in designing course emphases for more effective instruction and counseling.

WELDING

Dictionary of Occupational Titles Code Number	Office of Education Code Classification	Occupational Title	Competencies Necessary for Initial Employment	Recommended Additional Training
616.38	17.2304	Welder, pipe making	17	Machine shop Metals, Forging
810.131	17.2306	Welder, supervisor,pipeline	1 through 20	Certification
810.782	17.2306	Welding, machine Operator, arc	1 through 11	Certification may be necessary
810.782	17.2306	Welder, scam	12	Metals
810.782	17.2306	Welder, butt	12	Metals
810.884	17.2306	Welder, apprentice, arc	7 through 11	Metals
810.884	17.2306	Welder, arc		
		Boilermaker welder	7 through 11	Metals
		Gas shielder arc	12 through 20	Metals
610.884	17.2306	Welder, gun		
		Hand submerged arc	12, 13	Metals
		Heliarc	14 through 20	Metals
810.884	17.2306	Welder, tack	7,12,15	Metals
810.081	17.2306	Welding, engineer	1 through 20	Post-secondary experience
811.782	17.2306	Welding machine operator, gas	1,2	Metals
811.884	17.2306	Welder, gas automatic	1 through 6	Metals
811.884	17.2306	Welder, apprentice, gas	1 through 6	Metals
811.884	17.2306	Welder, production line	1 through 20	Metals
811.884	17.2306	Welder apprentice, combination	1 through 20	Metals

Number	Classification		Competencies	Training
811.884	17.2306	Welder, combination and repair	1 through 20	Metals
819.301	17.2306	Welder-Fitter	1 through 20	Metals
819.301	17.2306	Welder-Fitter, apprentice		
		Arc	7 through 11	Metals
		Gas	1 through 6	Metals
819.381	17.24	Welder tester	1 through 20	Metals
819.887	17,2306	Welder, helper	1,2,7	Metals

Most of the above occupations require on-the-job experience, in addition to training to become thoroughly competent.